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# Research Briefs

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## Nutrition and Health

**Plan on nursing your baby after delivery?** You'll be happy to know that a few of those extra pounds you gained during pregnancy will help your baby thrive. Recent findings show that stored body fat contributes about 60 percent of the fat in breast milk, and milk fat is the infant's major source of energy. The mother's diet contributes about 30 percent of breast milk fat; the breast synthesizes the rest. These estimates agree with findings from large animals. In the unique study, three nursing mothers consumed saturated and mono- and polyunsaturated fatty acids labeled with a harmless, nonradioactive isotope of hydrogen so that researchers could follow their fat metabolism all the way through milk production. Since a nursing mother puts out about 20 grams of fat in breast milk each day, researchers estimate each pound of body fat supplies enough fat for 3 to 4 weeks.

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**If athletic rats are any indication,** human athletes may be able to endure a little longer and compete a little better with a little more chromium in their bodies. Marathoners and other long-distance athletes prepare for competition by eating a high-carbohydrate diet to stockpile all the glycogen—the storage form of glucose—their muscle tissue will

hold. But how fast the glycogen disappears during competition may determine who finishes first—or who finishes at all. Rats fed adequate chromium for 5 weeks lost significantly less muscle glycogen during strenuous exercise than those fed a low-chromium diet. The average chromium intake for U.S. men is two-thirds the minimum currently thought to be adequate. U.S. women average only half the minimum. Good sources of chromium are fortified breakfast cereals, cheese, liver, whole wheat, beef, beer and wine.

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**More evidence that boron could be essential** for optimal health surfaced recently in a study with older men and women. Using an electroencephalograph (EEG), one researcher found striking differences in brain wave patterns between periods of low and adequate boron intake—0.23 vs 3 milligrams per day—suggesting the volunteers were less alert when their boron intake was low. Another researcher found signs that boron depletion reduces copper status. Copper is thought to be important in preventing heart disease as well as bone and joint disorders.

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**Nature appears to be watching out for you,** judging from findings on how the body deals with certain types of cholesterol products. Cholesterol oxides are chemical compounds that can form in any food containing cholesterol when the cholesterol meets air at high temperatures, such as in frying and some forms of processing. Among the 60 to 80 known cholesterol oxides, the alpha-epoxide and the beta-epoxide have been reported to be carcinogenic in animal experiments. But ARS studies with simulated gastric juices indicate that both the alpha-epoxide and beta-epoxide break down rapidly in the human stomach, changing into other noncarcinogenic cholesterol oxides.

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**Even drug-resistant malarial parasites** didn't take hold in mice fed a diet enriched with fish oil and deficient in vitamin E. Fatty acids from the fish oil may be incorporated into either the parasite's membranes or membranes of

the host's red blood cells. But without any vitamin E to protect membrane integrity, the organism self-destructs. Mice who were started on this diet 1 to 4 weeks before being infected with a large dose of parasites were free of them 3 to 4 weeks after infection. If people respond similarly, the dietary approach developed by ARS and University of Miami researchers holds promise for prevention and treatment of this recalcitrant disease. Far from being subdued, malaria is back with a vengeance. The latest estimate is that nearly 300 million people in Africa, Latin America, Asia and the Pacific are infected. Malaria claims the lives of one quarter of African children under the age of 4.

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**One-month-old infants** can't absorb cereal—or so the experts thought—because they don't produce the main starch-digesting enzyme until they're 4 to 6 months old. New findings show they can digest cereal at one month, but that doesn't mean they should get it. The 10 infants studied absorbed an average 88 percent of the rice cereal mixed with their formula—one tablespoon per ounce. But they didn't retain any more calories or protein from the cereal-formula mixture than they got from formula alone. The extra nutrients passed out in the stool, suggesting there's no nutritional benefit to feeding cereal to very young infants. Also, the cereal may reduce absorption of needed minerals. The American Academy of Pediatrics recommends not introducing cereals before 4 to 6 months of age unless the infant frequently spits up liquid formula. Mothers often start feeding cereal earlier, however, to help infants sleep through the night. The findings so far support the current recommendations.

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**Breast-fed infants are more fuel-efficient** than formula-fed infants, burning significantly fewer calories when they sleep. In a study of 40 healthy infants, the 20 who were breast fed expended 5 percent less energy per day than the 20 formula-fed infants at one month of age and about 12 percent less by 4 months. The difference was in their sleeping, or basal, metabolic rates, not in their activity levels, according to the first 24-hour measurement of energy expenditure in healthy infants. The findings partly explain why breast-fed infants get by on about 20 percent fewer calories than formula-fed infants by the fourth month. They also grew more slowly, as seen in other studies. This study is part of ongoing research to redefine the energy requirements of rapidly growing infants. The current Recommended Dietary Allowance was derived from calorie intakes of predominantly formula-fed infants and is substan-

tially higher than the intakes of breast-fed infants. Based on the study's findings, mother's milk provides adequate energy during the first 4 months. Formula-fed infants funnel some of their excess calories into growth and burn the rest.

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**From breath samples alone**, scientists at an ARS center in Houston, Texas, were able to identify which infants would have difficulty absorbing glucose sugar—the basic unit of cereals and all other complex carbohydrates. And they determined the degree of malabsorption. The Houston center is a world leader in developing and using harmless, nonradioactive isotopes for nutrition research. With partial funding from the National Institutes of Health, the Houston scientists collaborated with researchers in Brazil, France and East Germany to study glucose absorption in infants from each country. They found that infants with chronic diarrhea lost most of their ability to absorb glucose, whereas severely malnourished infants without diarrhea handled glucose almost as well as healthy infants. All 17 of the study infants had been given a solution of glucose enriched with a naturally occurring variant of carbon, which was later measured in the carbon dioxide they exhaled. In a related study, the researchers are investigating the use of locally available cereals as nutritional supplements for infants who can't absorb lactose, or milk sugar, during acute gastroenteritis.

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**Folic acid supplements**—often prescribed during pregnancy—can interfere with zinc absorption when body zinc stores are low. And they can reduce the body's ability to mobilize stored zinc during stress, such as strenuous exercise, according to a series of ARS studies of men and women. Supplements of the vitamin (also called folacin or folate) that contain 400 micrograms or more could cause problems for vegetarians who eat fewer zinc-rich foods and for pregnant women. Low zinc status in mothers is linked to low birthweights of their infants. Among its many functions, zinc is involved in protein synthesis—crucial in a developing fetus—and in immune function. Cooperative studies with scientists at Wright State University in Dayton, Ohio and Tulane University in New Orleans found that women with the highest blood levels of folic acid and the lowest levels of zinc had the most infections during and after delivery. The findings suggest that obstetricians should prescribe a zinc supplement along with a folic acid supplement. Ironically, people need zinc to absorb folic acid from foods.

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## **Tomorrow's Foods**

**Beta III**, a carrot rich in beta carotene, is now receiving high marks for flavor and good growth in diverse geographical settings. This carrot, developed by ARS scientists, provides hope for improved nutrition—eye health and disease resistance—throughout the world. Beta III is three to five times richer in beta carotene than most other carrots. Favorable reports have come from agricultural scientists in 15 of 16 developing countries who received generous amounts of free seeds from a U.S. company. A square foot of land typically produces slightly more than a dozen of the new carrots, enough to meet an adult's vitamin A needs for about a month. Globally, vitamin A deficiency is considered one of the most common dietary problems, ranking behind total energy and protein deficiencies. In the United States, more than 40 percent of Hispanics, 20 percent of blacks and 10 percent of Caucasians may consume less vitamin A than they need. Carrots, which now account for about 14 percent of the vitamin A in U.S. diets, may contribute increasing amounts as scientists learn more about carotene absorption and try to keep on improving carrot eating quality and carotene content.

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**Sunflower seeds** have twice as much iron as raisins, as much calcium as whole milk and all the protein of beef, without any cholesterol. (That's on a pound for pound, dry weight basis). And now there are three tasty new ways to eat them: Sour cream and onion flavored, honey roasted or a roasted and salted raisin blend. The new taste treats are part of a sampler of three North Dakota crops packaged by the National Sunflower Association and Sigco Sun Products of Wahpeton, N. Dak, to celebrate the state's centennial. The sampler also contains soybean and wheat snacks. ARS researchers developed the sunflower hybrids whose seeds are used in these snacks. This research has given new life to the active sunflower industry in the United States and renewed vigor to export markets in Europe, the Middle East and Asia. According to the National Sunflower Association, in 1988 over 80 percent of the nation's sunflower crop was exported, either as oil or seed, bringing in \$204 million.

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**Minced fish** may someday partially replace ground meat in certain cured meat products, if researchers can resolve concerns over compounds that might be formed in the products. Some meat processors want to add fish to cut costs, increase nutritional quality and improve binding and gel characteristics. Adding just 5 percent minced fish to meat franks alone would boost by about 45 million pounds

the demand for fish. But there's a hitch to this gastronomic marriage. Nitrite must be used in cured meats to prevent botulism and give these products their pink color and characteristic flavor. Fish are especially high in chemical compounds called amines. Nitrite can combine with amines during processing to form nitrosamines, some of which are potent carcinogens. Since the nitrosamines found are in very low concentrations, researchers are studying variables such as the species of fish used, the age of the fish before processing and its time in frozen storage to see how these affect the level of nitrosamines in the product. The USDA's Food Safety and Inspection Service has already approved a nugget product that combines meat and processed minced fish.

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**Citrus growers in south Florida** and coastal areas may get bigger harvests and healthier trees from a new rootstock. Just released to nurseries after 14 years of tests in Florida, Sun Chu Sha is a Chinese citrus rootstock that thrives in Florida's flatwoods. Not only does it efficiently use the small amount of magnesium available from the soil, but Sun Chu Sha also resists citrus blight, citrus tristeza virus and *Phytophthora* foot rot, which plague citrus groves in this area. The rootstock also did well in Texas where soil conditions are similar.

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## **Food Freshness and Safety**

**Milk sugar**—lactose—can reduce the number of *Salmonella* bacteria in infected chickens by 99.9 percent for just pennies per bird. And D-mannose—a natural sugar produced by a Mediterranean plant—is as effective but costs more. The sugars were added at 2.5 percent to the drinking water of newly hatched chicks dosed with 100 million *Salmonella typhimurium*—the species most often responsible for food poisoning. Compared with chicks that received bacteria but no sugar, only 53 percent of the birds getting lactose and only 26 percent of those getting D-mannose had any of the bacteria after 10 days. More importantly, the birds treated with either sugar had 99.9 percent fewer bacteria than the control birds. The cost of adding lactose might be no more than 2 cents per bird, whereas use of D-mannose would cost about 50 cents based on today's price. Other sugars, including glucose, sucrose (table sugar), and maltose (malt sugar) were tested but proved ineffective.

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**Melons that look and smell ripe** at the supermarket are often picked too soon to be sweet. To solve this problem, ARS engineers have developed a device that uses light rays to measure just how sweet melons like honeydew, watermelon and cantaloupe are. The breadbox-size device can monitor sweetness in melons by measuring the amount of near-infrared light the fruit absorbs. The more infrared absorbed, the sweeter the fruit. Unripe melons with only 6 percent sugar can sweeten in just a few days on the vine to an ideal sugar content of 11 percent. Besides helping farmers pinpoint when a melon is ripe for picking, the meter should make it easier for wholesalers and retailers to identify vine-ripened fruit. Someday consumers may have purse-size sweetness meters to take to the produce market. So far, the meter also works for onions and papayas. Peaches and nectarines will be tested next.

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**Ever bite into a crisp-looking apple** only to get a mouth full of mush? Fruit researchers are working to remedy that. With a technique called spectrophotometry, they can now detect invisible bruises on apples. This method breaks down a light beam into its individual colors, or wavelengths. In a cooperative effort between ARS and Cornell University, researchers bruised apples and directed a beam of light to different parts of the fruit. Damaged areas showed lower light reflectance, indicating the bruised areas absorbed the light. Undamaged sections reflected

more light, characteristic of a healthy apple. Packinghouses could use this technique along with equipment they now use for color sorting.

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**Potatoes that naturally resist the leafhopper**, a pest that requires extensive use of pesticides to control, need only to be developed into commercial varieties. Without pesticides, leafhoppers can cut yields by more than half in the East and North. ARS researchers selected parent stock from potatoes that showed the best natural resistance to the pest in successive generations. After 7 generations of selection, plants from the improved germplasm had 45 percent less leafhopper damage than plants from the original, unselected stock. A commercial variety from this stock would allow the use of less pesticide.

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**A new, longer lasting lure** for trapping the Mediterranean fruit fly (medfly) may become an important defensive weapon for California, Arizona, Texas, Florida and other states susceptible to invasion by this destructive insect. Agricultural agents in those states monitor thousands of traps equipped with a lure to detect incoming medflies before their populations have a chance to build. The medfly can infest more than 250 different fruits and vegetables and can easily cost millions of dollars to eradicate. Called Ceralure, after the medfly's scientific name (*Ceratitis capitata*), the new formula lasts at least 2 to 3 times longer than Trimedlure, the most widely used medfly bait. That could mean impressive labor savings for states such as California, which runs 30,000 medfly traps.

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